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Original Research Article

STUDY OF SERUM ELECTROLYTES WITH PARTICULAR REFERENCE TO SERUM MAGNESIUM IN BRONCHIAL ASTHMA PATIENTS

Nayana Deb[1], Suman Kumar Singh[2], Madhu Sinha[3]

[1]Assistant Professor, Department of Biochemistry, PMCH, Patna, Bihar, India
[2]Tutor, Department of Biochemistry, PMCH, Patna, Bihar, India
[3]Professor, Department of Biochemistry, PMCH, Patna, Bihar, India

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Corresponding Author:
Dr. Suman Kumar Singh,
Email: drsksinghdbg@gmail.com

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Abstract

Background: This study is done to verify the hypothesis that the electrolyte values among the intermittent asthmatic patients will be found to be better than those of persistent asthmatic patients. **Materials and Methods:** This prospective observational study was done in Department of Biochemistry, Patna Medical College, a Tertiary care Hospital of Bihar. The study duration was 12 months from January 2022 to December 2022. A total of 44 patients were included, who fulfilled the inclusion criteria and who gave consent to participate in the study. The study received an ethical approval from the ethical committee. Blood samples were drawn under aseptic precautions from clinically diagnosed cases of acute severe asthma before and after the administration of nebulised salbutamol. Both the blood samples were analysed for the study parameters. **Result:** 95% of the persistent group is said to have Hyponatremia followed by the intermittent and control group. Persistent group shows high distribution 95% for Hypokalemia, followed by intermittent with 0% for control. 100% is seen in both intermittent and persistent group. About 90% of the study population is seen to have hypocalcaemia. 100% Hypophosphatemia is seen in the intermittent group followed by 95% in persistent group and nil in control. **Conclusion:** The study showed that asthmatic patients presented with Hyponatremia, Hypokalemia, Hypomagnesaemia, Hypocalcaemia or Hypophosphatemia. The association of hypo magnesium and Hypokalemia was seen strongly in asthmatic patients.

INTRODUCTION

Long standing inflammatory condition of the airways is commonly known as asthma which affects people of all ages. It exerts a sizeable burden on the patients, their families, and the community.[1] It's an illness due to the complementary action between factors that affect at molecular level and the external soundings. The most commonly quoted hostile factors are airborne pollutants which can be indoor or outdoor, high salt intake, indoor allergens, drugs and vaccines.[2]

Respiratory symptoms are characterized with severe attacks that require immediate first aid, if not can lead to death. The burden of asthma is enormous, about 300 million people are currently suffering from asthma worldwide, and about 30 million are living in India.[1,3] Asthma is associated with limitations in day to day activities, absence from school and work days, impairment of lung function, quality of life is reduced, and an unfavourable socioeconomic burden.150 lakh years are lost every year because of asthma, which is approximately 1% of the whole worlds burden of disease.[1]

About 3-38% in children and 2-12% in adults, is currently estimated to be the prevalence of asthma, which is one of the commonest chronic disorder among children.[4] An Indian Study put the prevalence of asthma in India to be around 2.05% among those aged >15 years, with an approximate national burden of 18 million asthmatics.[5]

A large number of asthma patients are over confident about their control level. Exacerbations (67%) have been reported by Indian asthmatics, with a good amount of functional and emotional limitations.[6] This on the whole shows how poorly asthma is controlled and reflects how inadequately treatment is taken up by the patients. The use of bronchodilators, inhaled corticosteroids, and influenza vaccinations is seen in low-income countries like India.[7]

Acidosis and hypoxemia can result due to the use of beta- adrenoceptor agonists and other sympathomimetic bronchodilators, during acute episodes of bronchospasm, which can increase the risk of cardiac arrhythmias.[8]

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It's commonly seen and expected that a derangement exists in the serum potassium levels in asthmatic patients undergoing beta 2- agonist therapy.[9,10] The first electrolyte that was found to be deranged and subsequently reported in cases of acute asthma was Hypokalemia and was due to beta 2-agonists and aminophylline therapy.[11-13]

The long term implications of using beta 2 -agonists are tremors, tachycardia, palpitation, and anxiety which are commonly seen.[14] Later, asthmatic patients treated with beta 2 agonist were also been reported with hypomagnesaemia, Hypo-phosphatemia, and hypocalcemia.[15,16]

The adverse effects of beta 2 -agonists caused while managing acute asthma is one of the main reasons for the increase in mortality rate and which is still on the rise.17 The use of non-selective beta 2 -agonists (Isoproterenol) and Fenosterol for the treatment of asthma saw increased death incidence in the 1970's.[18] Cardiac arrhythmias can be precipitated by Hypokalemia, Hypomagnesaemia and Hypocalcaemia.[19,20] The possibility of worsening of respiratory failure during acute severe asthma by the impairment of respiratory muscle performance is seen when there is Hypophosphatemia.[21] According to Global Initiative for Asthma (GINA) classification of asthma, Intermittent asthma will have <1symptom per week with <2 nocturnal symptoms per month. In Persistent asthma will have >1 symptoms per week with >2 nocturnal symptoms per month.[1]

There are only few studies related to above subject and its clinical relevance. This study is done to verify the hypothesis that the electrolyte values among the intermittent asthmatic patients will be found to be better than those of persistent asthmatic patients.

Aims and Objectives:

1. To evaluate serum electrolyte levels in Asthmatic patients.
2. To compare the serum Magnesium between Intermittent and Persistent asthmatic patients.

MATERIALS AND METHODS

This prospective observational study was done in Department of Biochemistry, Patna Medical College, a Tertiary care Hospital of Bihar. The study duration was 12 months from January 2022 to December 2022. A total of 44 patients were included, who fulfilled the inclusion criteria and who gave consent to participate in the study. The study received an ethical approval from the ethical committee.

Inclusion Criteria

All 44 patients clinically diagnosed with acute severe asthma who were treated with nebulised salbutamol were included in the study.

Exclusion Criteria

Patients who were aged less than 18 years, those with metabolic disorders, pregnant women and psychiatric patients were also excluded from this study group.

Blood samples were drawn under aseptic precautions from clinically diagnosed cases of acute severe asthma before and after the administration of nebulised salbutamol. Both the blood samples were analysed for the study parameters.

After getting the written consent, 5ml of venous blood sample was drawn in a disposable syringe before the start of nebulised salbutamol therapy. Precaution was taken to prevent sepsis and haemolysis. The sample was then transferred to a mineral free acid washed glass test tube and was allowed to stand for 25-30 minutes, after which it was centrifuged to separate serum. Nebulised salbutamol (2.5mg) was administered every 30 minutes until the patient was discharged from the emergency department. Each dose was administered over a period of 10 minutes.[6] Apart from inhaled oxygen supplementation, no other drug was administered during the course of the treatment. A repeat blood sample was drawn 85 minutes after starting nebulised salbutamol therapy, as the peak serum concentration of salbutamol is reached at 85 minutes. The repeat samples were processed similarly to separate serum.

The levels of the four electrolytes (Magnesium, Calcium, Phosphate, and Potassium) were estimated twice, before and after the administration of nebulised salbutamol to the same study group. The study group consisted of 60 clinically diagnosed cases of acute severe asthma.

RESULTS

The present study was undertaken to evaluate the significance of possible electrolyte abnormality in asthmatic patients. 44 Asthmatic patients divided into 2 groups of 22 each intermittent and persistent were considered with 44 healthy individuals chosen as controls. The cases and controls are divided into 5 groups (18-20years, 21-30yrs, 31-40yrs, 41-50yrs, and 51-60yrs). It shows the maximum numbers of controls are in the age group of 51-60yrs (43%) and the majority number of cases is also of 51-60yrs (38%). Table 5.2 gives the mean age of the control group as 44.56 years and that of the intermittent and persistent cases as 43.59 yrs. The age of the youngest person who participated in this study is 18 years and the oldest is 60 years with the mean age of 44.1 years. Out of 44 persons who participated in this study as control, 27 were males (61%), followed by 17 females (45.3%) whereas females were more in the case group with 24 females (55%) followed by males at 20 with 45%.

Among the 42 subjects who were a part of the study, 25 (59.52%) were men and 17 (40.47%) were women. 10 of the 42 patients were aged less than 25 years, while 15 patients were between the age group of 26 to 45 years and 17 were aged more than 46 years. The general distribution of the abnormal

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electrolytes between the cases and the control group. 95% of the persistent group is said to have Hyponatremia followed by the intermittent and control group. Persistent group shows high distribution 95% for Hypokalemia, followed by intermittent with 0% for control. 100% is seen in both intermittent and persistent group. About 90% of the study population is seen to have hypocalcaemia. 100% Hypophosphatemia is seen in the intermittent group followed by 95% in persistent group and nil in control. The baseline magnesium level before the administration of salbutamol in patients of acute severe asthma was 1.983 Â± 0.0221 mg/dl (Mean Â± Standard error) and it decreased significantly ($p < 0.001$) 85 minutes after the administration of salbutamol, to 2.002 Â± 0.0223 mg/dl.

Serum concentrations are depicted as Mean Â± Standard Error (SD)

[Table 2] shows the distribution of electrolytes between the intermittent and persistent asthmatic groups. The distribution of hypernatremia, hypocalcaemia and Hypophosphatemia between the intermittent and persistent group was found to be insignificant. The distribution of Hypokalemia and hypomagnesaemia is found to be significant.

Table 1: Age and sex distribution

Age group	Male	Female	Total
<25 years	7	3	10
26-45 years	9	6	15
>46 years	10	9	19
	26	18	44

Table 2: Distribution of electrolytes between cases

Serum Electrolytes	Serum level before treatment with salbutamol	Serum level after treatment with salbutamol
Magnesium (mg/dl)	1.983±0.0221	2.002±0.0223
Potassium (mEq/L)	3.053±0.0358	2.987±0.0356
Phosphate (mg/dl)	3.000±0.0300	2.999±0.0306
Calcium (mg/dl)	8.555±0.0324	8.576±0.328

DISCUSSION

The patients of acute severe asthma were treated with nebulised salbutamol alone and serum electrolytes were measured before and after 85 minutes of therapy to determine the magnitude of change in the serum concentrations. Serum magnesium, potassium, and phosphate levels decreased significantly after the initiation of nebulised salbutamol therapy, as compared to the baseline levels or the electrolyte levels before the initiation of nebulised salbutamol therapy. Serum calcium levels did not show any significant changes during the course of the study. The cause of hypomagnesaemia due to the β2â€“adrenergic agonists is still unclear, which can probably be explained by the epinephrine like action of the β2â€“adrenergic agonists on magnesium uptake by the adiposities. Hypomagnesaemia is associated with tremor, low potassium and ventricular ectopic activity. Interestingly, these adverse effects are seen in therapeutic or excessive doses of salbutamol. Therefore, hypomagnesaemia can be considered as a common denominator to help explain these effects of β2â€“adrenergic agonists.[12] Hypomagnesaemia may increase the neuromuscular irritability, thus making a few individuals more susceptible to the bronchial spasms. It is noteworthy that hypomagnesaemia which causes broncho-constriction is a side effect of salbutamol, which is a potent bronchodilator. However, this bronchoconstriction might be of a very small magnitude. A statistically significant decrease ($p<0.001$) in serum magnesium levels was observed in our study after the treatment with nebulised salbutamol, when compared with the baseline levels. A serial and statistically significant decrease ($p<0.001$) was also observed by Bodenhamer in his study, with an aggressive administration of nebulised salbutamol.[13] Khilnani also reported a decrease in serum magnesium levels with the use of the β2â€“adrenergic agonists.[15] However, a few studies have reported that no statistically significant change of serum magnesium levels was observed in patients who were treated with nebulised salbutamol.[14] In our study, serum potassium levels were found to decrease significantly after the treatment with nebulised salbutamol ($p<0.001$). A statistically significant decrease in serum potassium levels was also observed after salbutamol therapy in other studies,[4,10.12,13] and also in a study on patients of the paediatric age group.[14] Nevertheless, a study pointed out that only intravenous salbutamol led to a decrease in serum potassium levels, while nebulised salbutamol did not result in significant changes.[15]. Hypokalemia is known to occur in therapeutic and excessive doses of β2â€“agonists. This effect is attributed to the activation of the Na+-K+-ATPase enzyme and β2 receptor mediated insulin release, with a consequent intracellular shift of potassium.[16.17,18,19,20] The serum phosphate levels were found to decrease significantly in our study ($p<0.001$) after treatment with nebulised salbutamol and a similar observation was made by Bodenhamer in his study.[21,22,23,24,25]. Serum calcium levels did not show any statistically significant changes during the salbutamol therapy in our study. The limitation of this study was that randomisation and placebo control were not done, as they were not practically feasible in our setup. If the study had taken into

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account, the history of the asthma medications that the patients took before therapy, the results could have been attributed more directly to salbutamol therapy. Our study results indicated that serum electrolytes like magnesium potassium and phosphate decreased significantly in patients with acute severe asthma who were on treatment with nebulised salbutamol. The decrease in electrolyte levels was only statistically significant and the levels did not decrease below the decision limits. The mechanism and clinical significance of these findings are unclear and they warrant further studies. It is recommended that further studies must be carried out on a larger sample size and also, the clinical findings should be correlated with the dose dependent variation in electrolyte levels during salbutamol therapy.

CONCLUSION

The study was done to evaluate the electrolytes in asthmatic patients who were attending PMCH, Patna, Bihar. The parameters that were taken into consideration were serum sodium, potassium, magnesium, phosphorus and calcium. As expected there was derangement of serum electrolytes in the asthmatic patient such as Hypokalemia, Hypomagnesaemia, Hyponatremia, and Hypo-phosphatemia. Asthmatic patients showed electrolyte abnormality in combinations. The study also showed the probable existence of hypocalcaemia (below 8.5mg/dl) which was not statistically significant and probably warrants the need for a study involving a larger sample population to verify the significance if any. A similar finding of insignificance is to be noted with respect to hypernatremia. The population of the study were people from in and around Kulasekharam a place known to have plenty of rubber trees and stone factories providing the aetiology for a probable dust induced or allergen induced bronchial asthma. Various studies suggested the existence of serum electrolytes abnormality as a single entity or in combinations. This study was done to compare the electrolyte abnormality among the intermittent and persistent asthmatic cases with the hypothesis that as the intermittent patients required occasional medication their electrolytes would be better when compared with the persistent asthmatic group. The study showed that asthmatic patients presented with Hyponatremia, Hypokalemia, Hypomagnesaemia, Hypocalcaemia or Hypophosphatemia. The association of hypo magnesium and Hypokalemia was seen strongly in asthmatic patients. Between the asthmatic groups serum potassium, serum sodium and serum magnesium of the intermittent asthmatic group is found to be better compared to the persistent group.

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